CHANGES IN COMBUSTIBLE FAÇADE REGULATIONS AND TESTING IN AUSTRALIA

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Facade fires around the world have instigated a change in regulations for cladding fire safety in many parts of the world. The Grenfell Tower fire in London 2017 had resulted in an extensive investigation of many aspects of the fire, including into UK building regulations by Dame Judith Hackitt[1,2]. Key findings of the review of building regulations by Judith Hackitt are:

- Current regulations and guidance are too complex and unclear.
- Clarity of roles and responsibilities is poor.
- Despite many who demonstrate good practice, the means of assessing and ensuring the competency of key people throughout the system is inadequate.
- Compliance, enforcement and sanctions processes are too weak.
- The route for residents to escalate concerns is unclear and inadequate.
- The system of product testing, marketing and quality assurance is not clear.

Malaysia cladding requirements in the UBBL are drawn from British standards so while regulatory review conclusions are not directly applicable, there are some parallels. Australia's building regulations are performance based, with prescriptive options. A review of the Australian building compliance system was published in early 2018[3] with similar issues as raised by the Hackitt report. Changes have occurred in Australian state regulation, national construction code and fire test methods in response. Key findings are relevant for the comparison with the situation in UK, and Australia.

DEVELOPMENTS IN AUSTRALIA

Australia had several fires involving external wall cladding with two fires of note being the LaCrosse building[4] on 25 November 2014 and the Neo200 building[5] on 4 February 2019. These fires, in conjunction with several structural failures and the 2015 recall of Infinity electrical cabling, have also driven government response to the wider risk of non-conforming building products.

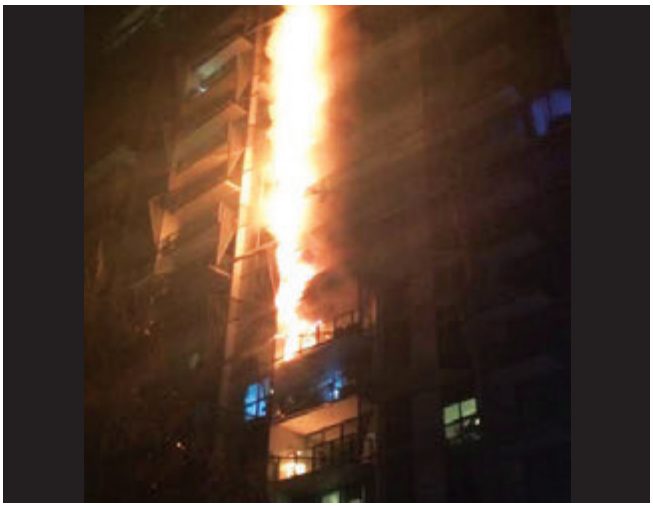


Figure 1: Lacrosse Façade fire, 2014, Docklands, Melbourne, Australia

A review of the Australia building compliance system is presented in the Shergold & Weir report[3], published in early 2018. This report, although from an Australian context identified some issues similar to those raised by Dame Judith in the Hackitt report. Twenty-four recommendations were made in the following areas:

- registration and training of practitioners
- roles and responsibilities of regulators
- role of fire authorities
- integrity of private building surveyors
- collecting and sharing building information and intelligence
- adequacy of documentation and record keeping
- inspection regimes
- post-construction information management
- building product safety

The Senate Economics Reference Committee (SERC) launched an inquiry into the use of non-conforming building products. The interim report was released on 6 September 2017. The Government response was released in February 2018. The final report was released in December 2018 (https://www.aph.gov.au/Parliamentary_Business/Committees/Senate/Economics/Non-conforming45th/Report).

Australia has a model building code; however, the country is a federation of states. The *National Construction Code Volume 1 Building Code of Australia Class 2 to 9 buildings*[6] (NCC) is indeed national. However, there are variations for each state both in the NCC and in state regulation and guidelines. The NCC sets requirements for fire safety by height and use (Class) of the building.

Buildings are generally divided into classes from 1 to 10. Domestic residences (single dwelling homes) are covered by 1 and 10 and are not relevant to this article. Residential apartments are covered by Class 2, hotel accommodation by Class 3 and public buildings (including hospitals and schools) by Class 9. While class 2, 3 and 9 have been the main focus of cladding safety audits and reviews in Australia due to the increased risk of sleeping occupants, combustible cladding presents problems on other classes of buildings, including office and retail.

The NCC does not provide a separate class for high-rise buildings. Instead fire safety requirements increase with building height within each building usage class. Unlike some countries, high-rise buildings are not considered separately and have additional requirements located in the main text.

Sprinklers are required for all buildings over 25m effective height and (as from NCC 2019) Class 2 and 3 buildings of 4 storeys or more but less than 25m effective height, require sprinklers with rationalised water supply and design requirements. The Fire Resistance Levels (FRL) of elements and other requirements are dictated by the type of construction, designated as Type A, B and C. Type C is most lenient. Type A construction is required for 3 or 4 level buildings (depending on Class).

Table 1: Type of fire resisting construction (from NCC Vol. 1 2019 Table C1.1)

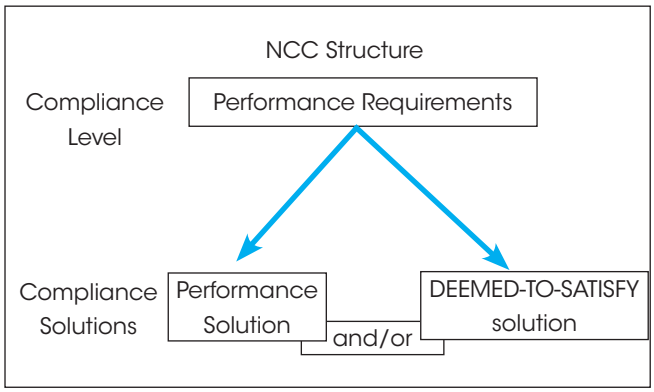
RISE IN STOREYS	CLASS OF BUILDING	
	2, 3, 9	5, 6, 7, 8
4 or more	A	A
3	A	B
2	B	C
1	C	C

NATIONAL CONSTRUCTION CODE (NCC)

The national construction code is a performance-based building code. Compliance with the NCC is achieved by complying with the performance requirements.

Performance requirements are satisfied by one of the following, as shown in Figure 1:

1. A Performance Solution.
2. A Deemed-to-Satisfy Solution (DTS).
3. A combination of (1) and (2).



For more than 20 years, the NCC (previously the Building Code of Australia) had set the DTS requirement that external walls for Type A and B construction must be either non-combustible, in accordance with AS 1530.1 testing or a limited set of materials (including plasterboard and coated metal sheeting and bonded laminates where the thickness of coatings or adhesives are strictly limited) which may be used wherever a non-combustible material is required.

However, due to industry failures identified by the referenced studies above, installation of DTS non-compliant combustible cladding on Type and B buildings in Australia had been prolific, in most cases not being appropriately supported by adequate performance solutions.

The NCC is amended on a three-year cycle, with the latest revision (NCC2019) coming into effect on 1 May 2019. However, more urgent changes driven by the Lacrosse and Grenfell fires were published in an out-of-cycle amendment to NCC 2016 (Vol. 1 Amendment 1), adopted on 12 March 2018[7].

NCC 2016 Volume One Amendment 1 includes the following changes:

1. The introduction of a new Verification Method (CV3) for testing of external wall assemblies for fire propagation. CV3 references a new testing standard, AS 5113-2016: "Fire propagation testing and classification of external walls of buildings"[8] and, in most circumstances, requires additional measures (e.g. enhanced sprinkler protection) and cavity barriers to mitigate the hazard presented by a combustible façade.
2. Revision of the NCC's evidence of suitability provisions, including clarifying the application and language of A2.2, strengthened wording of the current options, and a new requirement to consider the "appropriateness" of the evidence being presented to support the use of the material, product, design or form of construction.

3. Clarification of provisions, including provisions relating to external wall claddings and attachments, provisions that provide exemption to the non-combustibility requirements, and provisions that control the fire hazard properties of building elements.
4. Increased stringency for the sprinkler protection of balconies of residential high rise buildings through referencing an updated sprinkler standard, AS 2118.1-2017: Automatic fire sprinkler systems – general systems.

NCC 2019 Volume One includes the following changes:

1. Bonded Laminate Concession. The DTS clause permitting bonded laminated materials to be used with specified characteristics including limited adhesive layer thickness and controlled fire hazard properties, where a non-combustible material would otherwise be required remains for NCC 2019. The retention of the concession includes clarification that the lamina required to be non-combustible and includes any core. This clarification was made to prevent the incorrect interpretation that the concession could be applied to aluminium composite panels (ACPs) with a combustible core. A similar concession has been included to permit sarking-type materials up to 1 mm thick, and some other minor components (ancillary elements) have been exempted from the requirement to be non-combustible.
2. Fire sprinklers in Class 2 & 3 buildings. A requirement for fire sprinklers to be installed in apartment buildings and other residential buildings 4 storeys and above up to 25m in effective height, is included in the Deemed-to-Satisfy (DTS) Provisions with concessions for other fire safety features on account of the additional protection afforded by the fire sprinkler systems. As part of these requirements, two new types of fire sprinkler systems standards, FPAA101D and FPAA101H, have been developed which rationalised water supply and design requirements so as to reduce installation cost compared to AS 2118.1 sprinkler systems. For buildings over 25m effective height or buildings less than 25m effective height, applying the CV3 AS 2118.1 sprinkler system is still required. This means anyone using a DTS pathway for compliance for these types of buildings will need to install a fire sprinkler system. As part of these requirements, two new types of fire sprinkler systems have been included, as well as concessions for other fire safety features on account of the additional protection afforded by the fire sprinkler systems. (This was not introduced to directly address cladding fires).
3. Fire safety Verification Method. A new non-mandatory Fire Safety Verification Method (VM) will be introduced, with a delayed adoption date from 1 May 2020. The new VM, a voluntary tool under a Performance Solution pathway, provides for a documented process in the design of fire safety Performance Solutions and is based on the International Fire Engineering Guidelines (IFEG)[9]. (This was not introduced to directly address cladding fires).

PATHWAYS TO COMPLIANCE FOR EXTERNAL WALL FIRE PERFORMANCE IN AUSTRALIA

Figure 2 summarises the current NCC pathways to compliance for fire performance of external wall systems in Australia.

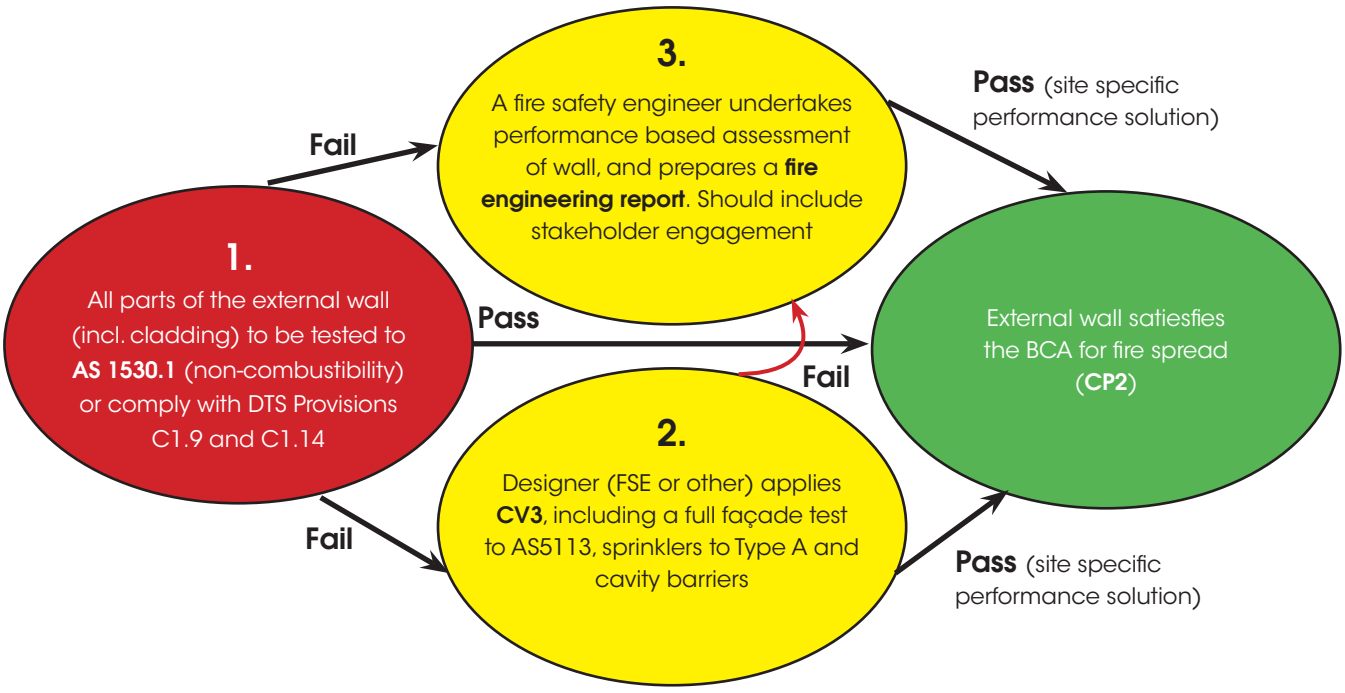


Figure 2: NCC compliance pathways possible for an external wall system relating to external wall reaction to fire (does not cover fire resistance requirements)

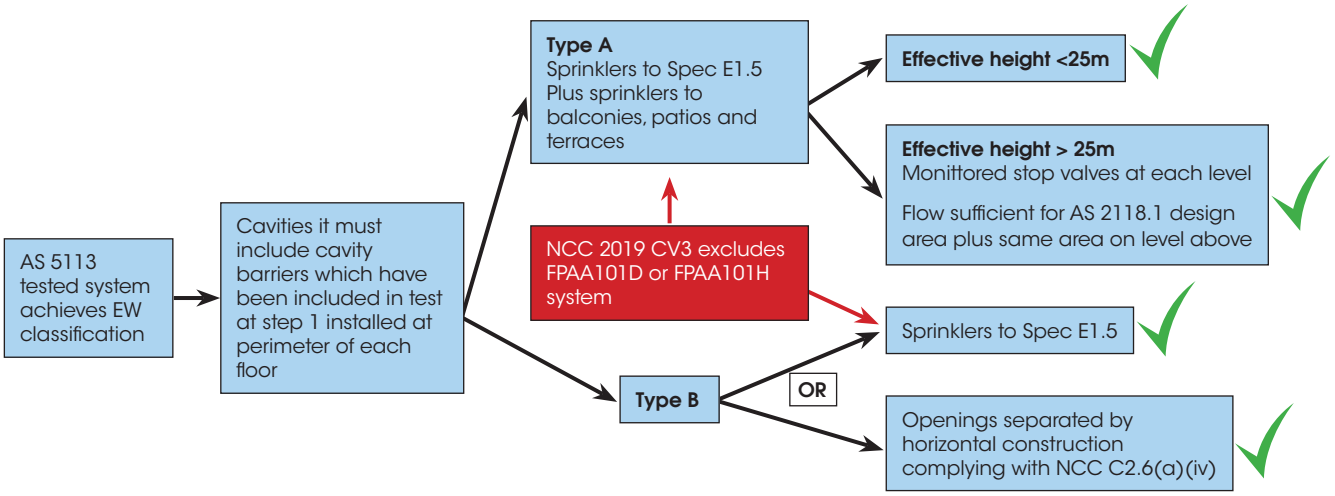


Figure 3: Summary of NCC CV3 requirements

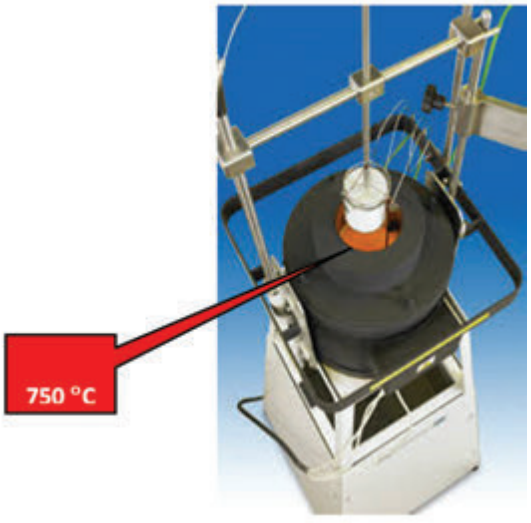
VERIFICATION METHOD CV3

Verification Method CV3 states that compliance with **CP2** to avoid the spread of fire via the *external wall* of a building is verified when the requirements summarised in the following flow diagram are satisfied.

AS 1530.1 COMBUSTIBILITY TEST

In AS 1530.1, small specimens are exposed to a temperature of 750°C within a small conical tube furnace. Criteria for non-combustibility are typically:

- The mean duration of sustained flaming (flaming longer than 5 s), is other than zero.
- The mean furnace thermocouple temperature rise exceeds 50°C.
- The mean specimen surface thermocouple temperature rise exceeds 50°C.



AS5113 FIRE PROPAGATION TESTING AND CLASSIFICATION OF EXTERNAL WALLS OF BUILDINGS

AS 5113 was first published in 2016 and provided a full scale façade fire test and classification standard based on BS 8414 or ISO 13785.2. In practice, only BS8414 method is currently being applied in Australia. The standards were selected after a review of the many different test methods[10]. The standard acceptance criteria are based upon BR135 with significant changes. This test method is not applied as NCC DTS but is applied to provide suitable evidence required for performance solutions.

In practice, most external wall systems tested to this standard rarely meet all the acceptance criteria. For example, falling debris criteria may be typically exceeded (e.g. melting of aluminum or spalling of concrete) even when criteria relating to vertical fire spread are not. Such tests may still be applied as evidence for performance solutions.

The following diagrams summarise the key features and acceptance criteria of AS 5113 applying BS 8414.

- Wing wall detail.
- Timber crib.
  - In combustion chamber.
  - Directly at base of façade.
  - Crib 1.5m wide x 1m deep x 1m high.
  - Crib mean mass ~400kg (±~80kg).
  - Crib Peak HRR =3±0.5MW.
- Extent of flame immersion and heat flux to external wall is greater than for ISO 13785-2.
- Critical temperatures measured at 5m above opening.

Figure 4: Key features of AS5113 applying BS 8414

CLASSIFICATION CRITERIA	CRITERIA LIMIT	DESCRIPTION
5.4.5(a) T_{w5m}	≤600°C	Temperatures 5m above the opening measured 50mm from the exposed specimen face shall not exceed 600°C for a continuous period greater than 30s.
5.4.5(b) $T_{cavity5m}$ 5.4.5(b) $T_{layer5m}$	≤250°C	Temperatures at the mid-depth of each combustible layer or any cavity 5m above the opening shall not exceed 250°C for a continuous period of greater than 30s.
5.4.5(c) $T_{Unexposedside0.9m}$	≤180K rise	Where the system is attached to a wall that is not required to have an FRL of –/30/30 or 30/30/30 or more, the temperature on the unexposed face of the specimen 900mm above the opening shall not exceed a 180K rise.

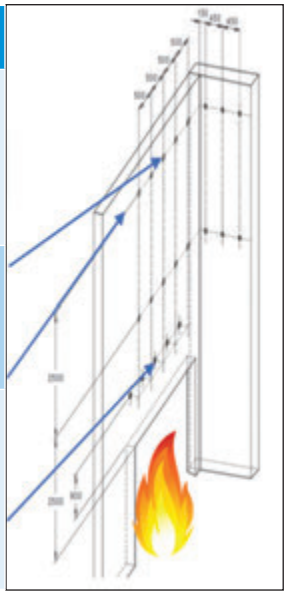


Figure 5: Temperature acceptance criteria for AS 5113 applying BS 8414

CLASSIFICATION CRITERIA	CRITERIA LIMIT	DESCRIPTION
5.4.5(d) Flaming 5.4.5(d) Opening	No Flaming No Openings	Where the system is attached to a wall not required to have a fire resistance of –/30/30, 30/30/30 or more, flaming or the occurence of openings in the unexposed face of the specimen above the opening shall not occur.
5.4.5(e) Spread	No Spread beyond Specimen	Flame spread beyond the confines of the specimen in any direction, as determined during the post-test examination, shall not occur. The examination shall include flame damage such as melting, charring but not smoke discolouration of staining of the surface, any intermediate layers and the cavity. Confines of specimen= • 2.4m horizontally on main test wall • 1.2m horizontally on wing wall • 6m vertically above top of combustion chamber opening

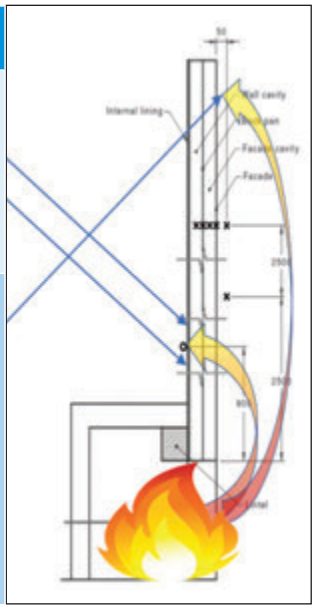


Figure 6: Fire spread and opening acceptance criteria for AS 5113 applying BS 8414

CLASSIFICATION CRITERIA	CRITERIA LIMIT	DESCRIPTION
5.4.5(f) Debris Flaming	≤20s	Continous flaming on the ground for more than 20s from any debris or molten material from the specimen shall not occur
5.4.5(g) Debris mass	≤2kg	The total mass of debris falling in front of the specimen shall not exceed 2kg. The mass shall be measured after the end of the test.

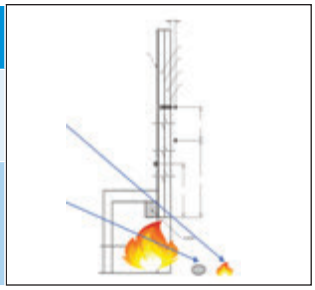


Figure 7: Debris acceptance criteria for AS 5113 applying BS 8414

STATE REGULATORY CHANGE AND RISK ASSESSMENT TOOLS

Most states have brought in new legislation regarding non-conforming products and combustible cladding. The Victorian Building Authority implements an audit process applying a Risk Assessment Tool (RAT), an approach similar to the NFPA EFFECT™ tool which has been developed by the Victorian Cladding taskforce and is applied during the audit and review process of the buildings.

The Engineers Australia Society of Fire Safety has published Society of Fire Safety Practice Guide Façade/External Wall Fire Safety Design 2019[11]. Several other guides have been published by the ABCB[12], CSIRO[13] and other state regulators.

CONCLUSION

The recent wall cladding fires triggered systemic reviews of regulation in many countries. The Hackitt report opening was severe "…the regulatory system (UK) covering high-rise and complex buildings was not fit for purpose …" we have seen further evidence confirming the deep flaws in the current system. Review in Australia was less stern; however major flaws were identified.

Many countries have made changes to building Acts, Regulations and Codes. Australia has amended fire test methods and regulation to address combustible cladding applied to new buildings. Investigation procedures for existing buildings and audits and risk assessment tools have been developed. These are steps towards remediation of the issues. Issues relating to consistency of requirements for combustible cladding between the different states within Australia and other countries remains a challenge.

These steps in improving and clarifying regulations and tests are the first step in enhancing fire safety of façade systems. However, ensuring compliance with regulations is a challenge.

Internationally, the trend is toward large scale tests (in addition to material tests) which represents the majority fire scenarios and ensures assessment of full scale and component interactions. Tests should be applicable to all wall system types and the field of application clear.

Buildings identified as having a risk of fire spread due to non-compliant cladding, can have the risk reduced as shown in response to the NEO200 building via interim rectification and fire service pre-planning.

Ongoing maintenance and confirmation of compliance throughout the life of a building is critical to ensure that fire safety systems, both active and passive, provide an acceptable level of life safety. External cladding systems are in place for decades, prone to alteration and damage from intentional works, accidental damage, weathering and ageing.

REMARKS FROM BUILDING SERVICES TECHNICAL DIVISION, IEM

Despite the current lack of legislation in Malaysia on external claddings in fire safety, the Malaysian fire authority (BOMBA) has already taken a proactive approach to implement the BS 8414 fire test requirement for designs of new buildings with external cladding system higher than 18m. The fire tests for such external claddings system is currently being carried out by SIRIM Malaysia at its test lab centre in Rasa, Kuala Kubu Baru, Selangor. To cope with the market demand, SIRIM Malaysia will have two test labs for this BS 8414 fire test in the near future. ■

REFERENCES

[1] Judith Hackitt. Building a Safer Future. Independent Review of Building Regulations and Fire Safety: Interim report. December 2017 https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/668831/Independent_Review_of_Building_Regulations_and_Fire_Safety_web_accessible.pdf.